DOI:
10.1016/j.midw.2019.02.008

Document Version
Peer reviewed version

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PII: S0266-6138(19)30039-7
DOI: https://doi.org/10.1016/j.midw.2019.02.008
Reference: YMIDW 2423

To appear in: *Midwifery*

Received date: 6 August 2018
Revised date: 9 November 2018
Accepted date: 8 February 2019

Please cite this article as: Naomi Carlisle , Paul T Seed , Lindsay Gillman , Can common characteristics be identified as predicators for seasonal influenza vaccine uptake in pregnancy? A retrospective cohort study from a South London Hospital, *Midwifery* (2019), doi: https://doi.org/10.1016/j.midw.2019.02.008

Title

Can common characteristics be identified as predicators for seasonal influenza vaccine uptake in pregnancy? A retrospective cohort study from a South London Hospital.

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Abstract

Background: Complications due to influenza are contributory factors for maternal deaths in the United Kingdom (UK). Less than half of all pregnant women in the UK receive the influenza vaccination. Increasing immunisation rates for seasonal influenza in pregnant women must remain a public health priority.

Method: A retrospective cohort study was undertaken, utilising the electronic health record of 4,817 women who had given birth at a South London NHS Hospital from 1st January - 31st December 2015. The data were then analysed to determine if there were any common characteristics of the women who received or did not receive the seasonal influenza vaccination.

Results: It was found that ethnic origin, age at booking, planned pregnancy, parity, and booking in the first trimester were significant predictors for receiving the seasonal influenza vaccination. Index of Multiple Deprivation Deciles, speaking English without a translator, and booking season were not clinically or statistically significant predictors for receiving the seasonal influenza vaccination.

Conclusions: There are common characteristics that are associated with receiving and not receiving the seasonal influenza vaccination for women who gave birth in South London during 2015. These results could be useful to antenatal health professionals working in similarly diverse areas, and to influence the public health agenda. This research ascertains which women in the cohort did not receive the vaccination; future research should explore the factors which affect vaccine uptake and potential strategies to improve vaccination rates.

Keywords: Seasonal influenza, Vaccination, Pregnancy, Antenatal.

Introduction

The 2014 confidential enquiry into maternal deaths across the United Kingdom (UK) found that 1 in 11 maternal deaths were due to complications from influenza (Knight *et al*., 2014). While the sample in this triennium of 2009-2012 was unusual because it included the A/H1N1 pandemic, the report added that more than half of the deaths could have been prevented by influenza vaccination and that 'increasing immunisation rates in pregnancy against seasonal influenza must remain a public health priority' (Knight *et al*., 2014, iv).

However, in the season 2014-2015, only 44.1% of pregnant women in England received their free seasonal influenza vaccination on the National Health Service (NHS) (Public Health England, 2015).

Influenza vaccination in pregnancy has no known adverse effects for the mother or baby (Salam *et al.,* 2015; Tamma *et al.,* 2009), and the Royal College of Midwives (RCM) and the Royal College of Obstetricians and Gynaecologists (RCOG) recommend the seasonal influenza vaccination during pregnancy (RCOG, 2015).

Considering the relative safety of the influenza vaccination and the recommendations from professional bodies, it is unclear why vaccination rates remain low. A comprehensive literature search was undertaken in 2015/2016 to inform the study design, which involved searching electronic databases, reference lists and a search for 'grey literature'. The search included studies from any country, including seasonal influenza and/or A/H1N1 influenza strains. A total of 42 articles were identified and critically appraised, but no studies were found that analysed the characteristics or predictors of seasonal influenza vaccination of pregnant women in the UK.

Methods

This study sought to determine whether any common characteristics could be identified as predictors of seasonal influenza vaccination within a defined cohort of women. A retrospective

cohort study was designed using data from the anonymised computerised health record of women who gave birth from 1 January to 31 December 2015 at a South London Hospital and met the inclusion criteria (Box 1).

Box 1 Inclusion Criteria

Inclusion criteria	Justification
Women who have given birth at the South London Hospital (either at home or in hospital)	Access to data due to contract of employment. The medical records used were records that would usually be available to the researcher in their role as a clinician.
Women who were over 16 years of age	Women able to consent to the vaccination
Women who gave birth at term (37 weeks' or more gestation)	As can be vaccinated at any stage of pregnancy, women may have given birth prematurely before they could receive the seasonal influenza vaccination
Women who did not have a termination of pregnancy	Women undergoing a termination were excluded because their reasoning to receive or not receive the seasonal influenza vaccination may be different when they are aware they are choosing this pregnancy outcome

Patient and Public Involvement was undertaken at a local parent and baby group to help identify and discuss which characteristics would be analysed.

Informed consent was not required for this study as it was a retrospective medical record review. The medical records used were records that would usually be available to the researcher in their role as a clinician. As a result, NHS ethics was not required.

Research and Development (R&D) approval was sought from the South London NHS hospital, which was granted. Meanwhile St George's University of London Research Governance reviewed and sponsored the study.

A pilot study was subsequently undertaken using 50 electronic records of women who gave birth in the year 2016 to ensure that the relevant information from the electronic records could be collected for the main study, and to highlight any potential pitfalls in the study design.

The literature review and data availability determined which characteristics to analyse (Table 1).

Table 1 Dependent and Independent variables

Variable type		
Dependent	Received the seasonal influenza vaccination	1= yes, 2= no
Independent	Ethnicity	1 = White British, 2 = White other, 3 = Black, 4 = Asian, 5 = Mixed ethnicity, 6 = Other, 0 = unknown
Independent	Season of booking	1 = Summer 2014, 2 = Autumn 2014, 3= Winter 2014/15, 4 = Spring 2015, 5= Summer 2015, 6 =Autumn 2015
Independent	Age at booking in years	1 = under 20 years, 2 = 21-25 yrs, 3 = 26-30 yrs, 4 = 31-35 yrs, 5 = 36+ yrs
Independent	Planned pregnancy	1 = no, 2 = yes
Independent	Speaks English without the need for a translator	1= no, 2 = yes
Independent	Booked within the first trimester	1 = no, 2 = yes
Independent	Primiparous	1 = no, 2= yes
Independent	The Index of Multiple Deprivation (IMD) decile - based on home address postcode	IMD decile 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 6, 7 = 7, 8 = 8, 9 = 9, IMD decile 10 = 10

The required data were collected from the anonymised electronic health record and a Microsoft Office Excel spreadsheet was produced to enable analysis using StataSE Version 14 (StataCorp, 2015).

The characteristics analysed were all categorical data. The eight characteristics were analysed as independent variables in a multiple logistic regression analysis, with the binary dependent variable being 'received the seasonal influenza vaccination'. All results, statistically significant or not, are reported.

After consulting the statistician Robert Grant, it was calculated that on the basis of a critical significance level of 0.05 (5%) and a power of 80%, 1,563 women would be needed in each both the vaccinated and unvaccinated group (n = 3,126) to detect a clinically important difference of 5% in the vaccination group. If the power was increased to 90% and then 2,079 women would be needed in both the vaccinated and unvaccinated group (n = 4,158).

Findings

The study sample included 4,817 women; with 1,966 women in the 'received influenza vaccine' group and 2,851 women in the 'did not receive influenza vaccine' group. These figures met the predetermined power calculations for the sample size.

Overall 40.8% of the participants received the seasonal influenza vaccination. This was lower than the national average uptake of 44.1% for the seasonal influenza vaccination in pregnancy (Public Health England, 2015).

The ages of the participants were normally distributed, giving a mean age at booking of 31.4 years, with a standard deviation of 5.7.

Black ethnicity was the most common among the sample (31.2%), then White British (30.7%) ethnicity. 2.9% of women were of mixed ethnicity, with 290 women (6%) having 'unknown' ethnicity recorded.

The Index of Multiple Deprivation (IMD) deciles are calculated by ranking areas in England (Department for Communities and Local Government, 2015). They analyse seven domains; income, employment, health and disability, education and training, barriers to housing and services, living environment and crime. These range from the most deprived 10 per cent of small areas nationally (IMD Decile 1) to the least deprived 10 per cent (IMD Decile 10). 27.4% of women in the cohort were in IMD Decile 2, meaning that they lived in the 10%-20% most deprived neighbourhoods. A cumulative percentage of 51.5% demonstrates that over half of the women in the sample lived in the lowest three deciles. A full table of characteristics and if participants received the seasonal influenza vaccination can be seen in Table 2.

T able 2 Characteristics and if received seasonal influenza vaccination

Received seasonal influenza vaccination?								Totals
	Ethnicity							
	Unknown	White British	White other	Black	Asian	Mixed	Other	
no	175 (3.6%)	779 (16.2%)	509 (10.6%)	979 (20.3%)	93 (1.9%)	96 (2.0%)	220 (4.6%)	2851 (59.2%)
yes	115 (2.4%)	702 (14.6%)	320 (6.6%)	524 (10.9%)	111 (2.3%)	45 (0.9%)	149 (3.1%)	1966 (40.81%)
Total	290 (6.0%)	1481 (30.8%)	829 (17.2%)	1503 (31.2%)	204 (4.2%)	141 (2.9%)	369 (7.7%)	4817 (100%)
	Season							
	Missing season	Summer 2014	Autumn 2014	Winter 2014/15	Spring 2015	Summer 2015	Autumn 2015	
no	12 (0.3%)	403 (8.4%)	584 (12.1%)	844 (17.5%)	770 (16.0%)	172 (3.6%)	66 (1.4%)	2851 (59.2%)
yes	16 (0.3%)	496 (10.3%)	601 (12.5%)	323 (6.7%)	369 (7.7%)	131 (2.7%)	30 (0.6%)	1966 (40.8%)
Total	28 (0.6%)	899 (18.7%)	1185 (24.6%)	1167 (24.2%)	1139 (23.7%)	303 (6.3%)	96 (2.0%)	4817 (100%)
	Planned pregnancy? Missing data	Planned	Unplanned					

		1852	975									2851
no	24 (0.5%)	(38.5%)	(20.2%)									(59.2%)
		1435	517									1966
yes	14 (0.3%)	(29.8%)	(10.7%)									(40.8%)
		3287	1492									4817
Total	38 (0.8%)	(68.2%)	(31.0%)									(100%)
	Requires a translator? Missing data	No translator	Requires a translator									
		2634										2851
no	24 (0.5%)	(54.7%)	193 (4.0%)									(59.2%)
		1868										1966
yes	14 (0.3%)	(38.8%)	84 (1.7%)									(40.8%)
		4502										4817
Total	38 (0.8%)	(93.5%)	277 (5.8%)									(100%)
	Parity Missing data	Primip	Multip									
		1305	1544									2851
no	2 (0.04%)	(27.9%)	(32.1%)									(59.2%)
		1069	896									1966
yes	1 (0.02%)	(22.2%)	(18.6%)									(40.8%)
		2374	2440									4817
Total	3 (0.06%)	(49.3%)	(50.7%)									(100%)
	IMD Decile from 1 - 10 Missing data	1	2	3	4	5	6	7	8	9	10	

no	9 (0.2%)	165 (3.4%)	827 (17.2%)	499 (10.4%)	520 (10.8%)	401 (8.3%)	209 (4.3%)	119 (2.5%)	80 (1.7%)	16 (0.3%)	6 (0.1%)	2851 (59.2%)
yes	5 (0.1%)	100 (2.0%)	494 (10.3%)	367 (7.6%)	366 (7.6%)	292 (6.1%)	183 (3.8%)	93 (2.0%)	50 (1.0%)	9 (0.2%)	7 (0.2%)	1966 (40.8%)
Total	14 (0.3%)	265 (5.5%)	1321 (27.4%)	866 (18.0%)	886 (18.4%)	693 (14.4%)	392 (8.1%)	212 (4.4%)	130 (2.7%)	25 (0.5%)	13 (0.3%)	4817 (100%

	Booked within first trimester?			
	Missing	Yes 1st trimester	No booked after 1st trimester	
no	2 (0.4%)	2032 (42.2%)	817 (17.0%)	2851 (59.2%)
yes	2 (0.4%)	1562 (32.4%)	402 (8.4%)	1966 (40.8%)
Total	4 (0.8%)	3594 (74.6%)	1219 (25.3%)	4817 (100%)

A multiple logistic regression was then undertaken using the seven characteristics to predict which women received the influenza vaccination. Pregnant women with missing data were not included in the final model (Donders *et al.,* 2006), therefore the model was undertaken on 4,457 women. A significant regression model was found ($P < 0.001$) with an R^2 of 0.0614.

It was found that ethnic origin, booking season, IMD decile, planned pregnancy, speaking English without a translator, parity and booking after the first trimester were significant predictors for receiving the seasonal influenza vaccination (see Table 3.

Table 3 Logistic Regression output

	Logistic Regression			
Characteristic	**N**	**Unadjusted OR**	**95% CI**	**P-value**
Age (under 20 years reference)	207 (4.3%)			
Age 21-25 years	585 (12.14%)	1.41	0.96 to 2.06	0.083
Age 26 - 30 years	1,091 (22.65%)	1.84	1.27 to 2.67	0.001
Age 31 – 35 years	1,783 (37.01%)	1.92	1.33 to 2.79	0.001
Age 36 years +	1,151 (23.89%)	1.85	1.26 to 2.70	0.002
Ethnicity (White British reference)	1,481 (32.71%)			
White other	829 (18.31%)	0.72	0.60 to 0.86	<0.001
Black	1,503 (33.20%)	0.72	0.61 to 0.85	<0.001
Asian	204 (4.51%)	1.53	1.12 to 2.10	0.007
Mixed ethnicity	141 (3.11%)	0.58	0.39 to 0.85	0.006
Other	369 (8.15%)	0.96	0.75 to 1.24	0.774
IMD Decile (Decile 1 reference)	265 (5.52%)			
IMD Decile 2	1,321 (27.5%)	0.92	0.69 to 1.23	0.576
IMD Decile 3	866 (18.03%)	1.09	0.81 to 1.48	0.568
IMD Decile 4	886 (18.45%)	0.91	0.67 to 1.24	0.533
IMD Decile 5	693 (14.43%)	0.89	0.65 to 1.23	0.493
IMD Decile 6	392 (8.16%)	1.15	0.81 to 1.65	0.432
IMD Decile 7	212 (4.41%)	0.95	0.64 to 1.43	0.820
IMD Decile 8	130 (2.71%)	0.90	0.56 to 1.44	0.659

IMD Decile 9	25 (0.52%)	0.70	0.28 to 1.75	0.445
IMD Decile 10	13 (0.27%)	1.02	0.29 to 3.58	0.977
Season (Summer 2014 reference)	899 (18.77%)			
Autumn 2014	1,185 (24.74%)	0.88	0.73 to 1.06	0.169
Winter 2014/15	1,167 (24.37%)	0.32	0.26 to 0.39	<0.001
Spring 2015	1,139 (23.78%)	0.42	0.35 to 0.51	<0.001
Summer 2015	303 (6.33%)	0.78	0.59 to 1.05	0.100
Autumn 2015	96 (2.00%)	0.49	0.29 to 0.84	0.009
Planned pregnancy (no is reference)	1,492 (31.22%)			
Planned pregnancy (yes)	3,287 (68.78%)	1.19	1.02 to 1.38	0.025
Speaks English without a translator (no is reference)	277 (5.80%)			
Speaks English without a translator (yes)	4,502 (94.20%)	1.33	0.97 to 1.83	0.074
Primiparous (no is reference)	2,440 (50.69%)			
Primiparous (yes)	2,374 (49.31%)	1.43	1.25 to 1.63	<0.001
Booked in first trimester (no is reference)	1,219 (25.33%)			
Booked in first trimester (yes)	3,594 (74.67%)	1.24	0.22 to 0.69	0.010

Discussion

Age

Age was found to be a significant predictor of whether women in this study received the seasonal influenza vaccination in the multiple logistic regression. Women who were above 20 years of age were more likely to receive the vaccination than women who were below 20 years of age.

Higher maternal age at booking and an association with receiving the influenza vaccination has been found in previous studies (Ahluwalia *et al.,* 2014; Blondel *et al.,* 2012; Cleary *et al.,* 2014; Dlugacz *et al,* 2012; Drees *et al.,* 2012; Freund *et al.,* 2011; Goldfarb *et al.,* 2011; Henninger *et al.,* 2015;

Howland *et al.,* 2013; Liu *et al.,* 2012; Mak *et al.,* 2015; Mendoza-Sassi *et al.,* 2015; Sammon *et al.,* 2013; Scheminske *et al.,* 2015; Steelfisher *et al.,* 2011; Yuen *et al.,* 2014). However, some studies found no statistical significant difference with regards to vaccine uptake and maternal age (Bhaskar *et al.,* 2015; de Ávila Kfouri & Richtmann, 2013; Eppes *et al.,* 2013; Maher *et al.,* 2013; Ozer *et al.,* 2010).

Ethnicity

Previous studies have found differences in influenza vaccination rates and ethnicity. However, as categories and definitions vary across countries no direct comparisons could be made.

This study found that women who classified themselves as White other, Black or Mixed ethnicity were less likely to receive the seasonal influenza vaccination compared to women of White British ethnicity. However, women of Asian ethnicity were more likely to receive the vaccination.

In order to make statistically robust comparisons, the original 16 categories of ethnicity were collapsed into six smaller categories. Consequently, slight variations between categories may have been missed.

IMD Deciles

IMD deciles were not found to be a significant predictor. Whilst other studies considered domains that are included in the IMD deciles, only two studies analysed socioeconomic deciles. Taskdal *et al.,* (2013) reported that women living in the most disadvantaged decile were most likely to receive a vaccination, however Sammon *et al.,* (2013) found the opposite with women in the least deprived IMD bracket being most likely to receive vaccination.

The statistically insignificant results may have occurred in this study due to the heterogeneity of London postcodes. Within the city, one postcode can contain a diverse mixture of housing, meaning they may not be reflective of poverty indices. This may explain the lack of a statistically significant result for this variable.

Booking season

While some booking seasons were found to be significant, a pattern or trend was not seen across the seasons. Therefore they are not clinically useful results. When analysing the data, the month of booking was allocated to one of six season categories. As a result, slight variations between the different months may have been missed.

Planned pregnancy

Planned pregnancy was found to be a significant predictor. Other studies have also found that women with unplanned pregnancies were less likely to receive the vaccination (Cleary *et al.,* 2014).

Need for a translator

The need for a translator was not found to be a significant predictor. These results could be seen as surprising as antenatal appointments where the midwife is using a translating service take longer than those without a translator. In a time limited appointment the midwife may not be able to fully discuss the usual antenatal information (including recommending a vaccination). Also, women may be aware of the vaccination advice, but be unable to access vaccination due to language difficulties. However, it may be that midwives working in this diverse area have a lot of experience of using

translation services, and are therefore able to adjust to language issues with ease. Only 5.8% of women required a translator, and the small data set could affect how valid these results are.

Parity

Parity was also found to be a significant predictor. However, previous studies have not demonstrated a consistent relationship between vaccination and parity. There are studies which suggest that nulliparous women were more likely to be vaccinated (Ahluwalia *et al.,* 2010; Drees *et al.,* 2013; Henninger *et al.,* 2013; Legge *et al.,* 2014; Liu *et al.,* 2012; Scheminske *et al.,* 2015; Yuen *et al.,* 2014), others found the opposite (Bödeker *et al.,* 2014; Blondel *et al.,* 2012; Cantu *et al.,* 2013; Sammon *et al.,* 2013; van Lier *et al.,* 2012; Yuen *et al.,* 2013). Three studies found that parity had no significance on vaccination rates (Bhaskar *et al.,* 2012; Eppes *et al.,* 2013; Wiley *et al.,* 2013). These differing results could be due to locational differences with regards to accessing the vaccination. The women in the study cohort needed to arrange a separate appointment with their primary care practice for vaccination. The lifestyle demands of multiparous women may have prevented them from attending additional appointments, a factor highlighted by Ahluwalia *et al.* (2010).

Booking after the first trimester

Booking within the first trimester was a significant predictor. These results may be because women who book after the first trimester are likely to have less antenatal appointments and therefore fewer interactions with clinical staff, meaning that the opportunity to discuss vaccination may be limited.

These findings are supported by Cleary *et al.,* (2014), with two other studies suggesting that those who received no antenatal care in the first trimester were also less likely to receive the influenza vaccination (Dress *et al.,* 2012; Liu *et al.,* 2012).

Strengths and weaknesses of the study

Strengths of the study include its large sample size. However, as the study cohort was from a single site, population inference is limited to areas with similar demographics. The study sampled produced a mean age at booking of 31.4 years. This is slightly higher compared to the national mean age of women giving birth of 30.0 years (Office of National Statistics (ONS), 2014). In the 2011 census, 3.3% of the UK population defined themselves as being of Black ethnicity (ONS, 2012). In this study cohort 31.2% of women were of Black ethnicity. Therefore the study cohort were not representative of the UK population. A bigger database, covering more regions (ideally all of England, Scotland, Wales and Northern Ireland), and analysing over a longer time period would be useful.

Overall, there were minimal missing data. However, for ethnicity, 6% of the study sample was classed as 'unknown ethnicity'. When utilising data from electronic health records, it is not possible to verify that the data are correct or why that category was selected. The reliance of hospital data is therefore a weakness of the study.

When filling in the health record the midwife would normally ask the woman if she received the vaccination or not. It therefore would not have mattered if the woman decided to receive the vaccination from another source (instead of their GP) or outside the NHS.

For some characteristics, (such as ethnicity, season of booking and parity) categories were condensed in order to produce more robust statistical comparisons. While this was a necessary step, slight variations between categories may have been missed. This could have affected the reliability of the results.

It was not recorded in the health record whether all women in the cohort had a discussion about the vaccination with a health provider and if it was offered to her. It is also not recorded if the vaccination was always readily available. The data available simply indicated whether vaccination

had occurred or not. Therefore data are limited to whether the woman received the seasonal influenza vaccination, and does not explore whether she accepted or declined the vaccination.

Future research

Future research is required to confirm or counter these findings. Utilising other research methodologies such as a prospective cohort study design or questionnaires for postpartum women may elicit additional information regarding accessibility of and attitudes towards seasonal influenza vaccination. This study highlights key characteristics of women who did not receive the seasonal influenza vaccination. Further research on the factors that influence the decision making of women to receive the seasonal influenza vaccination, and strategies to improve the uptake rate, is required.

1) **Conflicts of interest:** The authors have no conflicts of interest to disclose**.**
2) **Ethical approval:** Not applicable**.** Informed consent and voluntarily participation from the participants was not required for this study as the study design was a retrospective medical record review. As the medical records used were medical records that would usually be available to the researcher in their role as an employed clinician in the X Trust, Health Research Authority (HRA) ethical approval was not required. Ethical approval from University X was also not required for the same reason.

3) **Funding Sources:** This work was completed through a National Institute for Health Research funded Masters of Clinical Research degree awarded to NC. PTS is partly funded by Tommy's (Registered charity no. 1060508) and by CLAHRC South London (NIHR).

4) **Clinical Trial Registry and Registration number:** Not applicable

5) **Acknowledgments:** NC would also to acknowledge Jill Demilew for her clinical support during this MRes. The authors would like to acknowledge Robert Grant and Ahmed Younis for their statistical support.

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